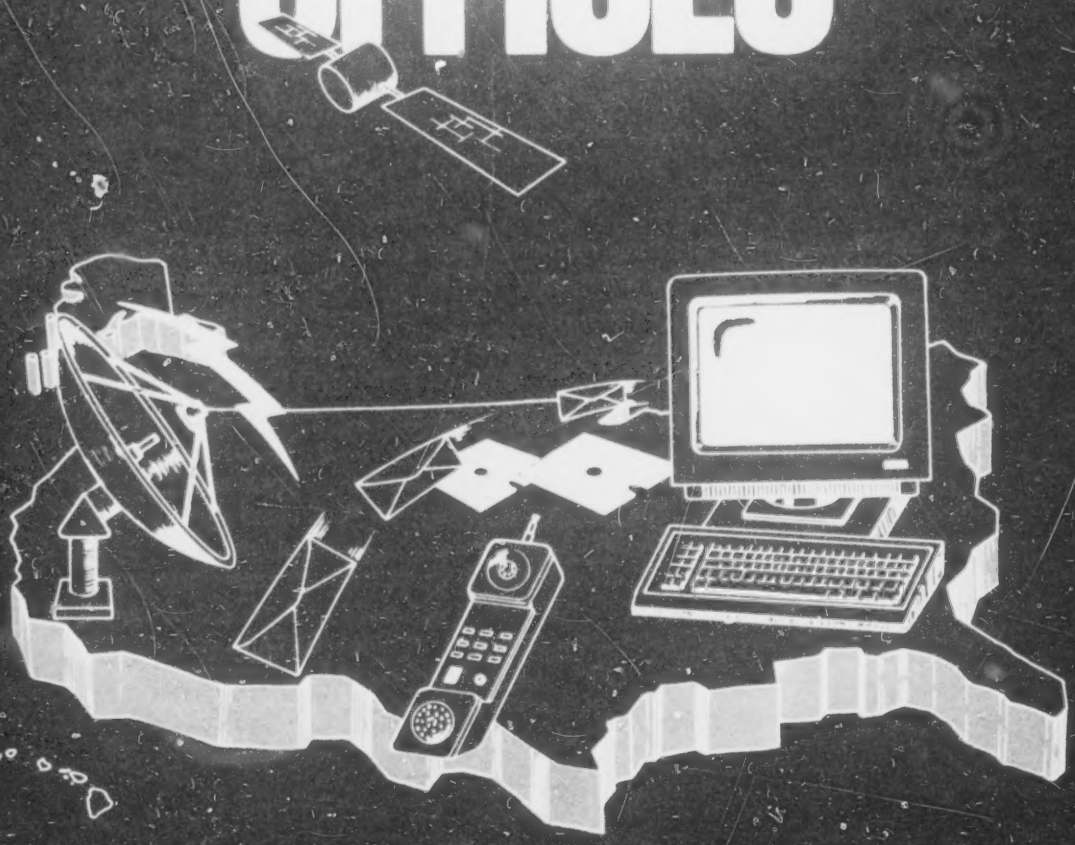
AUTOMATION OF AMERICA'S OFFICES



CONGRESS OF THE UNITED STATES
Office of Technology Assessment
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Summary

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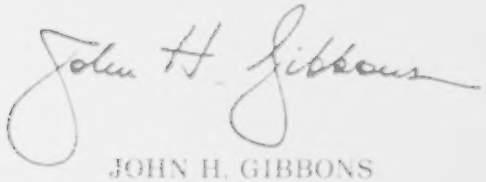
Foreword

Automation of America's Offices, 1985-2000, assesses the consequences of the continuing and rapid introduction of information and telecommunications technologies in offices: the workplace of about 45 million Americans. The use of computers and new communication systems in offices is bringing about fundamental changes in employment patterns, the skills needed for white-collar occupations, and the quality of worklife and the office environment. These changes will affect all industry sectors, since office work is a growing component of every industry as well as all public sector organizations.

The study, requested by the Senate Committee on Labor and Human Resources and the House Committee on Education and Labor, will also be of interest to many other congressional committees because it addresses a wide range of subjects of concern to industry, government, and educational institutions, and to employers, employees, and their organizations.

OTA wishes to thank the many people and organizations that contributed to this assessment through advisory panels, workshops, interviews, and other means of sharing their information and experience with us. The final responsibility for the study, however, rests with OTA.



JOHN H. GIBBONS
Director

Automation of America's Offices Advisory Panel

Charles E. Branscomb
Vice President, Telecommunications
Communication Products Division
IBM Corp.

Dennis Chamot
Associate Director
Department for Professional Employees
AFL-CIO

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Senior Specialist
Congressional Research Service
Library of Congress

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FBS Information Services

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Automation of America's Offices: OTA Assessment Staff

John Andelin, *Assistant Director, OTA*
Science, Information, and Natural Resources Division

Fred W. Weingarten, *Program Manager*
Communication and Information Technologies Program

Project Staff

Vary T. Coates, *Project Director*
Benjamin C. Amick III, *Analyst*
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Jon Turner
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Anne Posthuma
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Rand Corp.

Kathleen Christensen
Research Foundation of the City University of New York

Leslie Schneider
Harvard University, Kennedy School of Government

Marlene Thorn
IMT Associates

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Educational Fund for Individual Rights

Automation of America's Offices, 1985-2000

INTRODUCTION

Office automation is more than the replacement of typewriters by word processors and of bookkeeping machines by computers; it is a basic and far-reaching change in the technology that supports fundamental economic and social activities. As computers and telecommunications become standard equipment for office work, all Americans will be affected either as office workers or as users of office products and services.

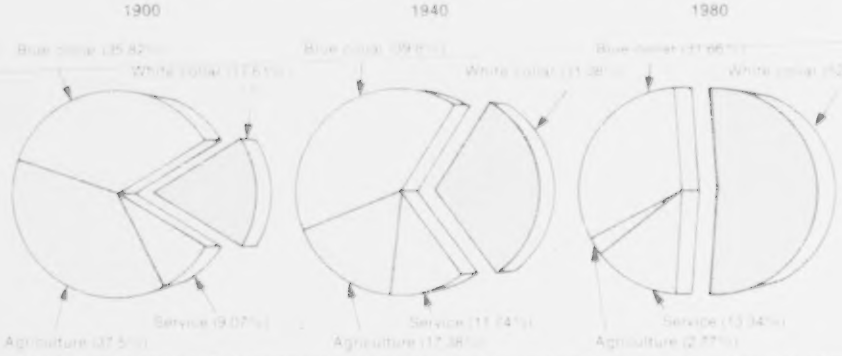
Information-handling is a growing component of all industry sectors. In some, such as insurance and banking, office work is the dominant activity; over half of all employees in the service industries and nearly 30 percent of employees of manufacturing firms are office workers. Information is as essential to our economy as are energy and raw materials. Increased productivity through office automation is thus attractive to all economic sectors.

Forty to forty-five percent of employed Americans work in offices. Twenty percent are clerical workers, 25 percent are managers or professionals. Office work has always been labor-intensive, and throughout this century, office employment has grown faster than other employment sectors. Now office automation, in the form of computers, telecommunications, and integrated office systems, is automating much of this white-collar work. **It is likely that growth in office employment, as a result, will slow over the next few years; it is possible that sometime in the 1990s the level of office employment will begin to decline.**

Whether or not this occurs depends on the dynamic interaction between the labor-saving effects of office automation—i.e., the increased productivity that it offers—and the increased demand for information and for new information-intensive products and services that office automation fosters. The possibility of significantly constrained growth or real decline in office occupations, in the context of declining blue-collar employment, emphasizes the importance of questions about the ability of the Federal Government to anticipate, identify, and respond constructively to the economic effects of technological developments in general, and those of rapid advances in communication and information technology in particular.

Changes in the nature of office work, in the demand for and the skills needed for many office occupations, and in the quality of office

Figure 1.—Changing Structure of the Work Force



SOURCE: 1900, 1940: U.S. Department of Commerce, *Historical Statistics— Colonial Times to 1970*, Series D. 182-232, and U.S. Department of Commerce, *Statistical Abstracts of the United States*, 1981.

worklife and the office environment are also important to the nearly half of all working Americans who will be directly affected. These concerns are especially strong for women workers and members of minority groups, who are heavily concentrated in jobs most likely to be affected by possible job reductions or de-skilling of work, but who also may benefit from the new opportunities offered by office automation. Small businesses also face special opportunities and problems as they consider automating their offices.

Public sector as well as private sector offices are being automated. Since about 80 percent of Federal civilian employees are office workers, this has important implications for Federal budgetary and personnel policies and planning. These implications also concern State and local governments.

The possibility of working or of having office work done in places remote from the central office—either in the home or "off-shore" in a developing country—is made economically feasible by emerging communication capabilities. Home-based and off-shore office work raise a number of complex policy issues, some just emerging and some already before Congress.

These and other opportunities, problems, and issues are discussed in this report, which was jointly requested by the Senate Committee on Labor and Human Resources and the House Committee on Education and Labor, with a further expression of special interest from the House Committee on Small Business.

THE TECHNOLOGY OF OFFICE AUTOMATION

By 1990, there may be a computer terminal for every three office workers. By 2000, terminals are likely to be as ubiquitous as telephones on office desks, and indeed the terminal and the telephone will often be combined in one piece of equipment.

Photo credit: Communication Workers of America

The computer terminal sits in many offices today alongside early office technologies such as the telephone and the microfiche reader.

Mainframe computers—large capacity computer systems—have been used in large organizations since the early 1960s. Both stand-alone word processors and minicomputers with multiple terminals became common in the 1970s. In the last 6 years, personal computers have invaded the office in force. For the next few years, a major trend will be the linking or networking of microelectronic equipment to produce integrated office systems.

In large offices, microcomputers supplement centralized electronic data processing operations, and are increasingly used by managers and professionals as well as by secretaries and other clerical workers. Small businesses can, for the first time, automate many of their office functions using packaged software such as spreadsheet and word processing programs in personal computers. Standardized and adaptable software packages promise to make computing available to all office workers, including those who know, and want to know, little of the esoteric world of bits, bytes, and Basic.

The dominant trends in office automation from 1985 to 2000 are likely to be:

- **steadily increasing use of small computers**, usually supplementing rather than superceding centralized automatic data processing;
- **networking**: widespread linking of microcomputers, minicomputers, mainframes, and peripheral and supporting systems;
- **decreasing reliance on customized programming**: more powerful, easier to use software and hardware will mean that computer professionals provide support to general users, rather than controlling information-handling;
- **machine communication**: growing capability for communication of voice, data, and text between computers, between locations, and between organizations, with decreasing need for translation of data from one media to another by people;
- **multiple options**: broad choice among technological alternatives for accomplishing most information-handling objectives;
- **increasing power, larger storage capacity, and more flexible processing** in computers of all sizes;
- **blurring of the distinctions** between mainframes and personal computers and between computing and communication systems; and
- **declining costs** per unit of computing power.

Much of today's keyboarding of text and data is likely to become unnecessary as a result of emerging technological trends. A large part of the clerical work in offices now consists of transferring information from one media to another—from voice to paper, from one document or form to another document, from paper to electronic form, and from one computer to another computer. Much of this work may be eliminated by recent and emerging developments. For example:

- Computers are increasingly able to communicate with each other through a variety of technological links. In the future, a buyer's computer may transmit an order to a seller's computer, which will order delivery and send an invoice (instructions for transfer of funds) to the computer in the buyer's bank, with notices of compliance flowing back along the same path.
- Information can go directly from paper into the computer without being keyboarded. Optical scanning technology or character recognition, already in use in some offices, is likely to improve rapidly in the next 2 to 5 years. Already, in some offices vouchers, checks, requisitions, and other standardized forms are fed into computerized data banks without keyboarding; even handwritten notations can to a limited extent be read and stored by computers.
- More and more documents will be in machine-readable form from the beginning, to be translated into conventional text only when needed.
- Data can be captured at the point of origin. Customers and clients will be allowed, or required, to enter data directly into the service organization's computer, as bank customers do now through auto-

matic teller machines. Point-of-sale terminals are another example of this trend.

- Integrated communication of voice, digital (numerical) data, and images will be increasingly available, and decreasingly costly.
- Practical speech recognition, for general office applications, is much further down the line than optical character recognition, but it is already being developed, and even used in limited ways. Speech recognition will allow both instructions and data to be entered into the computer by the spoken word.

Office automation may be adopted more rapidly, and have more widespread effects, than previous waves of technological change. Past automation has usually only affected one industry sector, or a limited set of occupations at a time. By comparison, many office functions are similar in all kinds of organizations (e.g., payroll operations, invoicing, and bookkeeping); thus, office automation as already noted can be used in all industries, and in both large and small organizations.

Office automation can be accomplished incrementally. It does not usually require the abandonment of existing equipment or facilities that represent large, long-term investments. Many complementary devices can, although not without some difficulties, be linked or networked to create integrated office systems, and because there is a wide choice among devices and systems, there are usually alternative ways of automating almost any information-handling task to fit the requirements and preferences of the organization. It does not appear that any foreseeable office information-handling needs will challenge the limits of rapidly evolving information and communication technologies.

The hardware and software of information and communication technologies are, however, only part of what is meant by office automation. In order to take advantage of their capabilities, it is nearly always necessary to reorganize the flow of information into, through, and out of the office. Different kinds of information may be needed—for changing reporting requirements, for different kinds of intermediate steps or analyses, to take advantage of opportunities to reach new customers or to offer new services. Information may have to be aggregated or categorized in new ways. Some traditional tasks disappear; some are merged to be done at the same time or place; others are simplified, or call for less judgment or knowledge. Usually the pace of work quickens, to keep up with the swift equipment; but it also becomes more dependent on equipment, subject to unanticipated disruptions when systems fail. The smooth flow of a process becomes essential, but some personal control over that process is, or is usually perceived by the workers to be, lost.

Office automation is thus characterized by, but not accomplished by, the introduction of electronic information and communication technologies; it is, more broadly, a reorganization of office work.

THE EFFECTS OF OFFICE AUTOMATION

Productivity

The productivity gains from office automation are likely to be large, and will increase over time. They can contribute to the competitiveness and productivity of all sectors of the economy.

With increased competition in both domestic and world markets, American industry is putting strong emphasis on cost reduction. This often means labor cost-reduction, including secondary labor costs such as health insurance, sick leave, and retirement benefits.

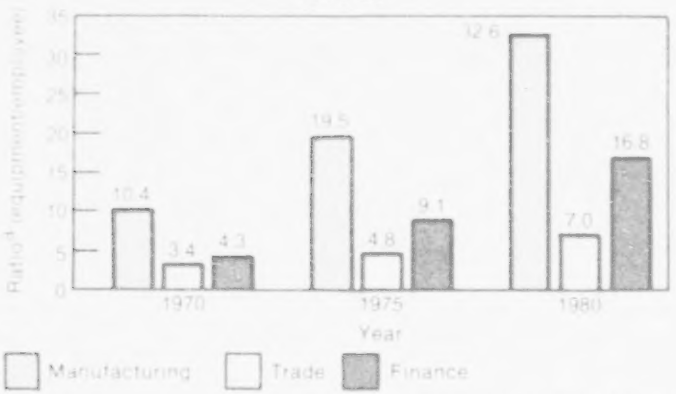
It is not yet possible to quantify the gains in productivity that can be achieved through widespread office automation, but they are significant. Office automation shortens the time required for many basic tasks from 15 to 85 percent. It eliminates some tasks, or the need for people to perform some tasks. For example, some firms have replaced multi-step mail processing operations that once involved many clerks—mail openers, sorters, typists—with an automated procedure that requires a mail-opening machine, and one or two computer operators who scan the mail and punch buttons to print out the correct response form and send it on its way. More information-handling can be done with less expenditure of resources (labor and time). This fits the standard definition of productivity: to produce the same or more of "X" with less expenditure of resources.

The estimates of 15 to 85 percent time and labor reduction, or more, in specific tasks or clusters of tasks, do not answer the question of what becomes of this time or labor. The consequences of office automation in terms of overall productivity for an organization are more difficult to measure and document, and to compare with those in other organizations.

In office work, productivity is difficult to measure, and is often defined loosely in terms of quality, timeliness, or other organizational objectives. Some offices automate in the hope of maintaining or increasing their output with fewer workers, or with lower paid workers. Others automate in order to improve their products or services, reduce error rates, cut delivery time, offer new information-intensive products or services, or reach a broader geographical market. The latter two objectives have been especially important in financial services industries. In manufacturing plant offices, improved coordination of organizational components or better inventory control are important objectives. When one company automates its office work, especially if it can then offer new services, competitors may feel compelled to automate also, even if they cannot conclude that it is immediately cost effective. Whatever the objective, however, there is some substitution of capital (equipment) for labor.

The employment effects of productivity gains have, in the early stages of office automation, often been either masked or delayed by

Figure 2.—Capital Investment Per Production Worker, 1970-80



[1]The ratio is net equipment stock (in billions of dollars) to number of production employees in constant dollars.

SOURCE: David Roessner, "Market Penetration of Office Automation Equipment: Trends and Forecasts" (working paper), School of Social Sciences, Georgia Institute of Technology, 1985.

transition problems, institutional lag, and external economic conditions. There is sometimes a prolonged transition period while the organization redesigns its procedures, workflow, and internal structures to better accommodate the new technology. This transition can be particularly long and troublesome when managers or workers resist change, or when they are given inadequate training and support.

Some organizations have been discouraged by the problems that they, or similar organizations, have in making the transition to automated offices. The rapid development of the technology makes it difficult for organizations to systematically plan their automation over the next decade, and makes some hesitant to undertake sizable investments when even better equipment may be just over the horizon. More recently, employment effects of office automation have probably been masked by the fact that slower growth in some office occupations has been attributed to economic recession.

There is usually some additional lag in realizing employment reductions, even when these transition problems are solved. For example, most organizations prefer attrition to layoffs as a mechanism for reducing their work force when jobs are eliminated. Therefore, early productivity gains may be small, and cost reduction is deferred. However, this lag may end in sudden large layoffs; recent announcements from several large companies indicate that this is happening.

During the late 1970s, it was frequently noted that employment in the insurance and banking industries continued to grow strongly while these offices automated rapidly. It was less often noted that employment was not growing nearly as strongly as sales and revenues, and that unit-labor costs began dropping about 1969 with the drop accelerating after 1975. In the 1980s, with renewed emphasis on cost reduction, labor force reductions are occurring in these industries.

These are short-term, transition problems, although they may constrain productivity gains for some time yet. Organizations are, however, sharing their learning and experience. Many of the transition problems can be solved by employers, employees, computer systems designers, and vendors working toward common goals. Office workloads in most sectors are growing, and the strong incentives to constrain or reduce labor costs will continue as a result of foreign competition. Thus, the pace of automation is likely to continue and even accelerate.

New products and services, organizations, and industries are likely to have automated offices from the beginning, avoiding many of the common transition problems that older organizations go through. In addition, even organizations that have successfully automated their offices typically reap further benefits from automation when other organizations in their environment—their suppliers and customers—also have automated office procedures. For example, auditors gain productivity when their clients' records are computerized. Thus, the realization of added productivity even from current automation should be a continuing benefit over the next 15 years, rather than a one-time accomplishment.

New Information Products and Services

The effects of office automation on economic growth and on levels of employment in office work will depend on the dynamic interaction between increasing demand for information-handling and increased productivity in information-handling. While information and communication technologies result in labor saving per unit of workload, they also create new demands for information and new ways of analyzing and using information, thus increasing the office workload.

Automation in the most thoroughly office-oriented industry sectors, such as insurance and banking, contributed to a proliferation of new products and services, and strong industry growth over the last decade. The technology itself spawns new firms or new industries; for example, videotext companies and database services.

The potential demand for information and the number of ways in which it can be used productively are not, however, unlimited. Intermediate (internal) uses of information are subject to the need for cost reduction in all operations, which will continue to be a strong driving factor for industry and government over the next 15 years. The market for new information-based services and products will be highly dependent on general economic growth, which may not be as strong in the future as it has been in past decades as American industries face strong competition from other nations.

Employment

The most likely outcome of office automation, in terms of office employment, is slowing growth over the next decade, and possibly a decline in office employment thereafter.

While the number of entrants to the work force is slowing, 18 million new jobs will be needed by 1995. The cumulative effects of substitution of capital for labor, work reorganization, time saving, and efficient workload leveling defy quantification, but are certain to significantly reduce the amount of labor required for a given volume of office information-handling. The extent to which demand for information—the office workload—will increase is less certain and is strongly dependent on the rate of growth of the economy as a whole.

Slowing growth is most likely in clerical employment, but may also be felt in lower and midlevel management positions and in some professional occupations.

This outcome is far from certain. Strong growth or continuing shifts in the economy, and thus continuing expansion of information-related work, may outweigh the work-reducing effects of office automation. Nor would slow growth in office employment necessarily strongly depress overall employment levels, since growth in other occupations could compensate for this effect, especially if higher office productivity contributes significantly to the productivity of American industry and its competitiveness in world markets.

But the possibility of reduced employment opportunities in office work, which provides jobs for nearly half of American workers and has been the strongest source of job creation throughout this century, is clearly something that Congress should watch closely in order to take corrective actions if needed in a timely fashion. The ability to anticipate and monitor such trends, unfortunately, is weak.

Substitution of Capital for Labor

The increased workload likely to be brought about by growing demand for information and for information services must be weighed against the strong labor-saving characteristics of office automation technology. The advances now occurring in optical character recognition, and other trends noted above which promise to reduce the necessity for keyboard entry of text and data, are likely to have an especially strong effect on clerical employment levels. Clerical labor is also affected by the redesign of workflow to take better advantage of the technology; this can lead either to rationalizing and simplifying tasks, or to "bundling" and integrating tasks that are now separate. Either strategy can eliminate some intermediate tasks and reduce the time required for others. Computerization is especially effective in reduc-

ing the time required for retrieving information, preparing it for use, translating data from one medium to another, and moving it from one work group to another or to the final recipient. The time required for many management and professional tasks, especially those involving communication and report preparation, can also be sharply reduced.

Because computers allow data to be integrated and used in ways not feasible by hand or electromechanical means, they also create new products and services. These, however, are not labor-intensive; they become feasible because they take minimum labor. Thus, it is not at all certain that increased office workloads will more than compensate for the labor-saving effects of office automation.

Changes in Occupational Distribution

Office automation changes the way that information flows between and within organizations, the way that work is distributed in an office, the way that people do their work, and the skills they need. It often confuses traditional expectations about the allocation of tasks between clerical, managerial, and professional workers. In many offices, clerical workers become expert at using computers to access data, monitor production activities, and formulate reports ("the professionalization of clerical work"), while professionals and managers begin to do their own word processing in drafting letters and documents ("the clericalization of professional work").

Lower level clerical positions, especially in which the tasks are narrowly defined, are most likely to be changed by further standardization and routinization, computer pacing and computer monitoring, and de-skilling. They are also most likely to be eliminated by new data input technology or by systems integration. Some clerical positions will, however, be broadened and enhanced in interest and skill requirements.

As organizations gain experience in automating clerical work, they are likely to turn their attention to automating the tasks of managers and professionals. Usually this will involve using information technology to support and facilitate their work, and to relieve them of some routine and repetitive tasks. But management or professional positions are not immune to the possibility of elimination, especially since a reduction in employment in these relatively highly paid positions has even greater possibilities for cost cutting than elimination of clerical jobs. Some organizations have declared a flattening of the corporate hierarchy to be a major objective in office automation.

Fewer clerical positions would also indicate a need for fewer first-line supervisors. Moreover, some applications of office automation allow the span of effective supervision to be broadened. Computers can also reduce the time required for, or completely automate, some of the other tasks of lower level managers, such as collecting, formatting, and presenting data to higher level managers; or this work can

be simplified and delegated to less highly paid clerical workers. Rapid access to data banks can save time for managers, and expert systems can assist them in making decisions, or even automate some decision-making. On the other hand, the availability of more detailed information for monitoring individual and organizational performance may well add to the workload of middle and upper level managers. More efficient communications can reduce the time they spend in exchange of information, but will probably also increase the number of exchanges in which they participate. Thus, the effects of automation on management and administrative employment are likely to be mixed.

The demand for professional services, in an information-intensive society, may continue to increase. Professional work can, however, benefit from the labor-saving effects of office automation. Computers can decrease the time spent in many of their data-gathering tasks. Some of the specialized knowledge and analytical techniques traditionally acquired through lengthy education can, through expert systems and software programs, be made available to less highly trained people, allowing professional work to be taken over by paraprofessionals or clerical workers. Thus growth in professional employment may be constrained.

Photo credit: Board of Realty Information Service

By connecting to the computerized multiple listing service, a realtor can show the property without leaving the office, greatly reducing the time investment necessary in a sale.

52-645 0 - 85 - 2

Photo credit: Michael Smith

An example of a factory-like office environment.

Part-Time and Temporary Work: Workload Leveling

About one in five American employees are part-time workers (one in four women workers are part-time). This proportion has been slowly increasing since the early 1950s, with most of the increase in involuntary part-time work. But the emphasis on cost reduction is now leading many organizations to emphasize work force reduction and rely on part-time and temporary employees to manage fluctuations in their workload. Some are converting full-time office workers to part-time, or using independent contractors. While this tends to increase the number of people employed, workload leveling allows more efficient use of labor-hours and thus potentially decreases the number of full-time office jobs.

Office automation may strengthen this trend. In large factory-like offices, computers can be used to rationalize and standardize tasks and to pace and monitor the work. This minimizes the training and experience that workers need to perform effectively, and the use of part-time workers also allows equipment to be used intensively.

Part-time and temporary workers usually are not entitled to benefits packages that provide many of the basic protections such as retirement income, medical insurance, and income during illness. There is some evidence that an increasing number of employers are adopting a strategy of converting a significant portion of their full-time work force to part-time status to reduce their benefits-related costs burden. To the extent that automation facilitates the conversion of full- to part-time workers, a growing proportion of the work force will be without essential protections.

The public interest concern with part-time and temporary work is thus twofold: that it not cause a deterioration in family income levels because of excessive conversion of full-time jobs to part-time, and that it not shift the costs of workers' protection from employer to employee to a degree that ultimately causes these costs to be borne by the taxpayer.

Public Policy and the Uncertainty of Employment Forecasts

Government capability for making both technological and employment forecasts, and especially for integrating these activities to produce better understanding of structural shifts in the economy, is poor.

Several recent employment forecasts have indicated continued strong growth in office employment. There are reasons to doubt these expectations. The Bureau of Labor Statistics (BLS) based its forecasts of growth in office occupations on projections of growth in specific industries where these occupations are concentrated. But BLS probably greatly underestimated the effects of new information technologies now in use, and largely ignored impending developments in those technologies such as those discussed above. This BLS forecast is reportedly now being revised.

BLS projections of employment have historically been insensitive to emerging technological change. Employment forecasts in both the public and private sector generally use formal models that do not reflect current and developing trends in basic technologies, in world economic conditions, in corporate structure, and in social behavior.

In general, technological or socioeconomic forecasting is a poorly developed discipline, and there is little Federal support for or attention to improving this essential capability or integrating it into economic and employment policy formulation. In Federal civilian agencies, there is, for example, little activity directed at forecasting or monitoring the rapid developments in information and communication technology, and recent budget cuts have further reduced those efforts. Further, the need for systematic and continuing data collection and analysis bearing on many labor-related trends and policy issues, including occupational shifts, compensation patterns, training needs, health and safety, and other points, is noted throughout this report.

The expectation of slowing growth in the number of information-handling or office jobs is based on many complex factors, each of which contains within it many inherent uncertainties. The possibility of this outcome, however, makes it important that the Federal Government improve its capability to recognize, anticipate, and respond in a timely fashion to structural changes in the economy as a result of both productive technological developments and changes in the global economy. Office automation and the potential for reduced growth or decline of white-collar work is only one among many long-range economic shifts

that may result from continuing technological development, but it is an important one.

Private sector organizations also need better information on which to base corporate strategies for smoothly implementing office automation with full regard for the interests of their investors, their employees, and their customers. To a large extent, private organizations must rely on government to gather and aggregate this kind of data through censuses, economic statistics, and employment indicators.

Strong policy interventions with regard to structural economic shifts can, if taken too early, abort promising technological development or frustrate innovative private sector solutions to the problems of economic transition. If taken too late, they may be ineffective and allow unnecessary damage to the welfare and stability of people, families, and whole communities that are left behind as the economy changes. Policymakers, in short, need early understanding of the interrelated trends that are bringing about change.

Training and Education

Employers must have trained workers to achieve the full benefits of office automation. For office workers, access to training and the ability to learn new skills is essential. Office automation tends to place a further burden on those who are already educationally disadvantaged.

About 75 percent of the workers for 2000 are already in the work force; they must master new skills either on the job or on their own time after work. Clerical workers must learn to operate the equipment effectively; managers are faced with learning both new systems and new techniques of management and supervision. One-time retraining

Photo credit: Manpower Inc.

Training and retraining are necessary to stay abreast

is not sufficient, because office technologies are continually evolving, with tasks being redesigned accordingly.

People just entering the work force, or attempting to transfer from blue-collar jobs to office jobs, will need training that many public schools, vocational schools, and colleges are not yet able to supply. Public schools and colleges have difficulty in responding to the rapidly changing needs of students and employers. Both the need for new equipment and the need for instructors to continually upgrade their skills puts a strain on educational resources. Commercial training institutions may be somewhat better able to respond to the changing market, but the quality of this training varies considerably and there are few mechanisms for evaluation and accreditation; some workers find they have invested in inadequate or obsolete training.

Organizations often underestimate the investment that will be needed in training and support for new systems. Attempting to skimp on these costs is one of the major sources of transition problems for organizations.

Training provided by vendors and by some employers is highly system- and task-specific. For employers, this minimizes investment in a worker who may leave, and replacements can be trained swiftly. For employees, it makes training easy, but may trap them in dead-end jobs and limit their opportunity to move either upward or laterally.

Some employers are providing extensive training for their employees. Industry surveys indicate, however, that many organizations offer little or no retraining of their workers, that managers are more likely to receive training than clerical workers and to get more extensive training, and that an overwhelming majority of office workers feel that the training they are provided is inadequate. As it becomes easier to recruit workers who already have experience in automated office work, the training provided by employers tends to decrease or to be shifted in the direction of supplementary education for organizational executives. At the same time, there is a strong and continuing trend toward lateral recruitment of upper level employees (i.e., hiring someone from a comparable position in another firm), or relying on university business schools to train managers, rather than promoting lower level employees. Thus, internal career ladders may tend to disappear.

Increasingly, office workers must rely on their own resources and initiative to get their basic training or retraining for career mobility. This puts those with the least income at a further disadvantage, which is compounded when they have little discretionary time because of family responsibilities (especially married women and single parents) or are already educationally disadvantaged.

Existing programs for Federal aid to vocational education and job training provide a mechanism for improving the quality and availability of training for work in automated offices. However, funding for these programs has been declining.

The Changing Nature of Office Work

Automation will bring fundamental changes in the nature of most office skills, tasks, occupations, and jobs. It can be used to enhance jobs as well as to de-skill them; it offers an opportunity to recast issues of equal opportunity and pay equity.

Many office workers initially fear new technology and have doubts about their ability to cope with it. After gaining experience with office automation, they overwhelmingly report that they like it. However, workers sometimes report that after an early honeymoon period their work has become both less satisfying and more demanding.

Because of the wide range of choice in technological systems and devices, in how they are applied, and in how the work and the work environment is reorganized around the technology, management strategies can determine whether jobs are enhanced or degraded in quality. One strategy is to use office automation to rationalize and "de-skill" work—i.e., to reduce it to simple, precise, repetitive actions that require no thought or judgment. For highly routine work, such as processing vast amounts of standardized data, this can work well from the standpoint of cutting costs and increasing management control. However, it is also susceptible to long-term growth of overhead costs. It makes errors difficult to detect and correct, degrades the response to customer needs or complaints, and tends to produce job dissatisfaction, poor motivation, and high employee turnover because it is tedious and boring. At the extreme, this can result in an "office factory" that recreates some of the worst problems of the early manufacturing-plant production lines.

Another strategy is to use automation to bundle or merge tasks, expand the boundaries of jobs, and enhance their interest for the worker. This electronic reintegration of tasks attempts to rationalize the work process as a whole rather than rationalizing each step separately. It is possible because the technology allows the efficient integration of information from many sources and its efficient distribution to many locations. The worker can concentrate on a coherent objective from the beginning to the end of a series of tasks, such as providing a service to the satisfaction of a specific customer, rather than being forced to endlessly repeat one suboperation. There is greater interest and motivation, and a means of feedback and self-evaluation. This strategy may, however, require increased training costs and greater management skills.

Many tasks that were traditionally at the cross-over point between clerical jobs and management or professional jobs have been automated. This truncates some job ladders that were important paths of career development. Computerization has also given rise to new occupations and career paths, and "the office systems guru," who has by trial and error made himself/herself an expert and provides help to other computer users, is a widely recognized figure.

Most organizations will need to systematically revise job definition and classification schemes and reanalyze internal promotion paths.

This provides a valuable opportunity for reexamination of the effectiveness of their policies related to equal opportunity, pay equity, and comparable worth.

There is more flexibility in implementing office automation than in most changes in basic technology. Strategies that give the worker an opportunity to participate with management in decisions about office systems and the redesign of work appear to work especially well. Since most office workers are not unionized or covered by collective bargaining agreements, this calls for innovative mechanisms for labor-management cooperation. Where office workers are organized, they are not guaranteed an opportunity to participate in office automation decisions, since technology decisions are generally considered a management prerogative. Automation can blur the lines between management and labor. Existing labor laws and collective bargaining mechanisms are framed around blue-collar work, and often do not fit the conditions in offices. New ways of involving office workers in decisions about automation and work redesign are needed.

The Quality of Worklife and the Office Environment

Automation has raised concerns about the long-range effects of work-related mental and physical stress, and fears about the effects of computer visual display terminals, or VDTs. These concerns merit further monitoring and investigation.

Concentrated work at a VDT frequently produces complaints about eyestrain and musculoskeletal problems that increase with the amount of time spent at the VDT. Such discomforts degrade the quality of worklife and probably lower productivity as well. There is no evidence as yet that visual strain leads to organic changes in eyes. Evidence from other occupations with heavy workloads and repetitive tasks suggest that musculoskeletal strain in VDT work could lead to chronic health effects.

These discomforts can be minimized by better workstation design, improved human/computer interfaces, and regular work breaks from long periods of VDT work. Since relatively few office workers are represented by unions, the question of a government role in regard to these problems has arisen. At least 20 States are now considering, and two have passed, legislation on a range of actions including ergonomic standards or mandatory rest breaks. Several States have developed new procurement guidelines for the purchase of automated office equipment. The problem may ultimately be resolved at this level of government, but at the cost of standards, requirements, and levels of protection for workers that vary widely across States.

There is current concern about the possibility of concentrated work at a VDT screen causing miscarriages or the birth of children with physical defects. At least 14 clusters of reproductive failures or accidents have been reported among clerical VDT workers. Scientific research has failed to identify any cause related to VDT technology.

Epidemiological investigations have neither verified nor refuted the argument that these scattered reports indicate a relationship between concentrated work at VDTs and reproductive hazards. One problem is the lack of reliable data on the frequency of reproductive problems in the population as a whole, another instance of a lack of data needed by policymakers. A review of the evidence leads to the conclusion that there is at this time no good scientific basis for fear of VDT effects on reproduction, but these unexplained clusters and heightened public concern make it essential that scientific research and careful monitoring continue until the possibility is entirely ruled out.

The automation of office work can increase mental stress for regular users through the speeding up of work (computer pacing); increased workload; loss of control over the sequencing, timing, and nature of the work; continual monitoring of work by the computer; the worker's fears about the ability to learn new procedures; and the loss of old skills or status. Computer monitoring and pacing of work is especially likely to add to both mental and physical stress in situations where the worker has little control over the work.

Some kinds of increased stress can be viewed as desirable challenge, but continuing, unrelieved stress can be harmful. There has been considerable discussion of "the executive heart attack," but those at greatest long-term risk of the early onset of stress-related diseases are probably clerical workers. Many experts conclude that this vulnerability to certain chronic or acute illnesses is related to sustained stress at work, and that office automation can increase such stress. As work is redesigned, tasks redistributed, and managers and professionals spend more time at VDTs, related stress problems may spread. There has recently been an increase in workers' compensation claims based on the effects of mental stress, and some of these are specifically related to office automation. State statutes vary widely on the acceptability of such claims.

With growing evidence that long-term, high levels of mental stress are conducive to several kinds of acute or chronic illness, mental stress could emerge as the most important public health problem related to automated office work.

Several management strategies, including work redesign and involvement of workers in decisionmaking about automation, appear to be effective in reducing work-related mental stress, and are also reported to lead to greater productivity. There is, however, still much to be learned about the relationship between office automation, mental stress, and chronic or acute illness. This is another area in which Federal policymakers do not have sufficient information for making decisions; and resources for nationwide tracking and monitoring of critical trends are inadequate or nonexistent. Data for investigating this relationship are out-of-date, sparse, fragmented, and dispersed. Several sections of the OSHA legislation mandate research on emerging health problems related to new technology (including psychological

factors in such problems), and the Health Promotion and Disease Prevention Amendments of 1984 establish research centers that could contribute to knowledge in this area. At present, however, the emphasis in such research is on manufacturing technology and on blue-collar workers. Congress may want to direct OSHA and NIOSH to give additional attention to the emerging health and safety questions in office work.

Data Security and Confidentiality

Unless organizations take positive steps to increase the protections afforded data in decentralized computer processing, it may become necessary to systematically reexamine the effectiveness of existing privacy and security legislation.

Protection of data in computerized data banks has been a continuing concern for several decades. Decentralized ("end-user") computing adds to these concerns for several reasons:

- it gives many people the opportunity to see, change, add to, or delete the data in central data banks;
- data stored in small computers and on floppy disks usually do not have the physical and procedural safeguards provided for central data banks and large computers;
- information processing is increasingly done in dispersed locations, difficult to oversee or monitor; and
- people not trained or experienced in data management are often unaware of, or careless about, the laws and policies governing confidentiality and security of information.

Organizations that have well-established technological and procedural means for protecting centralized data storage and processing often overlook the vulnerability of data processed in small computers by uninstructed users. Surveys show that most private sector organizations have done little to assure that data are protected in this situation, or even that their employees who are not trained computer specialists are aware of their responsibilities with regard to confidentiality and security of data.

Existing privacy and security legislation is designed to protect data in large systems, and further is largely designed to allow individuals to protect themselves against misuse of personal data and violations of confidentiality. Violations of confidentiality that occur when data are widely distributed throughout an organization, without formal controls and with no audit trails to monitor their distribution and use, cannot easily be detected by the organization that is responsible, and can certainly not be detected by its clients. The legal liability of organizations for such violations is not clear.

Federal agencies appear to have gone slightly further than private organizations in attention to these problems. However, they face a growing challenge in balancing data protection against the benefits

of widely distributed data processing. Accountability in the use of public information, especially when it can be used for private gain, is increasingly difficult to assure because access to distributed and downloaded data in electronic form is virtually uncontrolled and unrecorded in many agencies. Because government generally collects more personal data about its employees than do most corporations, protection of government personnel data also merits special concern.

To the extent that routine government operations and essential economic activities in the private sector become dependent on microelectronic rather than paper-based records, they are more vulnerable to temporary disruption by power failures, whether caused by system overload, storms, natural disasters, or other factors. Such disruptions, even when brief, can cause serious acute or cascading problems, for example, in responding to local emergencies or providing essential information to utilities, police, or fire departments. When a community is hit by an earthquake, hurricane, flood, or series of factory explosions, electric systems may be knocked out, and computer records of where emergency supplies are located and how critical people can be reached may be inaccessible. Few organizations in either the public or private sector appear to have given much attention to means of continuing essential activities or alleviating the effects of their disruption.

The Office Takes on New Forms

The volume of clerical work done in homes as the primary work site, or sent off-shore to be done in Third World countries, may increase significantly in the next 10 to 15 years. Each of these alternatives to conventional office employment, made possible by improved capability and declining costs of telecommunications, raises complex policy issues. Some of these issues will reach Congress in the next session. However, if office automation significantly reduces the need for data entry by keyboarding, as expected, the economic attractiveness of both home-based work and off-shore data entry will eventually decline.

Home-Based Clerical Work

In the next session, Congress may be asked to consider: 1) encouraging home-based work through tax incentives or removing minor regulatory barriers, 2) banning home-based clerical work, or 3) providing more effective and systematic regulation of home-based clerical work.

With modern information and telecommunication technology, many kinds of office work can be done satisfactorily outside of the office. At least 30,000 Americans probably do some paid work at home using microelectronic equipment, and enthusiasts argue that as many as 15 million office workers could do their work at home in the future.

For most of these people however, working at home is an occasional occurrence, and their primary work site is still a conventional office.

Photo credit: Digital Equipment Corp.

A portable terminal can be connected via telephone lines to business computer systems.

Others are entrepreneurs providing office services to other organizations, and they use their home as the site of their consulting service or small business. This kind of activity is prohibited or constrained in some communities by zoning laws, although the extent of this constraint—a local issue—is not clear.

Issues now coming to congressional attention, however, are more relevant to another kind of home-based office work, formal home-work programs in which corporations farm out work to be done in the work-

er's home, usually on a piece-rate or hourly wage basis. This is generally clerical work, such as text or data entry, although it is sometimes computer programming, and most of these home-based workers are women. Some corporations regularly engage home-based workers for data entry; others offer this opportunity for continued employment to women who are leaving their jobs temporarily or permanently because they are having babies, to retirees, or to physically handicapped people.

There are probably only a few thousand clerical workers now using the home as the sole or primary work site, but technology now makes it possible and economically attractive for this number to increase dramatically in the near future.

Home-based clerical work has many advantages both for employers and employees. For employers, there are possibilities for significant cost-cutting, both in facility-related costs and in converting full-time employees to part-time, piece-work, or independent contractor status, thus reducing the burden of employee benefits and gaining flexibility in handling a fluctuating or uncertain workload. Several studies have concluded that home-based workers have very high productivity, in part because they are self-selected and highly motivated, in part because the employer usually is not charged for startup time, coffee breaks, and interruptions that would, in an office, be counted as "work time."

Work at home is also sometimes a way of holding on to valuable employees who would otherwise leave the organization, or of providing employment opportunities for retired persons, the physically handicapped, or those who must care for children or other family members at home.

Many employees eagerly seek the opportunity to work at home, as a preferred lifestyle. Some want to combine paid employment with child care or other family responsibilities. Women sometimes first decide to quit work to begin a family, and then find that they can maintain their skills and earn some income by working at home.

Additional reported benefits for home-based workers include greater autonomy in scheduling work and leisure, avoiding long commutes to work, and reduced spending for meals, clothes, and transportation. More time to spend with children is, however, the most frequently reported benefit.

Under some circumstances, however, the workers assume many of the overhead costs usually borne by employers, including the the costs of "setting-up" and other nonproductive work time, the cost of time lost to illness, the cost of medical insurance and pensions, a larger share of social security payments, and costs of facility space, electric power, and in many cases equipment and telephone service costs. Some home-based workers lease their equipment from the employer. The

workers rather than the employer assume the risk of fluctuations in the availability of work. Home-based clerical workers who are not paid piece-rates are sometimes, although not always, paid at lower hourly rates than those doing the same work in an office.

Several issues are involved in current controversy over home-based clerical work: the legal status of workers and the employee benefits protections to which they are or may be entitled, the extent to which they can be assured the protection of existing employment laws and regulations, the extent to which home-based work is a choice among reasonable alternatives, and the potential effect of expanding home-based work programs on workers in conventional offices.

Companies with formal home-work programs often classify all home-based clerical workers, including those who were previously employees, as independent contractors; as such they do not receive workers' benefit packages, and the company does not make social security tax payments on their earnings. IRS, however, has ruled that such workers are employees unless they have made a substantial investment in their equipment, and IRS has specifically excluded most word processors and small computers from that exception. The legal status and associated rights for home-based clerical workers may require further clarification.

Some people, usually women, report that they are forced to seek work to do at home because there is no other way to combine paid employment with heavy family responsibilities in the absence of affordable day care for their children. Physical disabilities prevent others from finding conventional employment. Thus, while almost all evidence shows that home-based workers value the opportunity to work-at-home, and many other workers would also like this opportunity, some do so because other alternatives are not possible or are less acceptable.

Opponents of home-based work charge that:

- It is difficult or impossible to regulate home-based work so as to provide workers with legal protections to which they are entitled, such as wage-and-hour and health and safety protection.
- If workers are unable to assume the costs of pensions and health care effectively, they will eventually have to be borne by general taxpayers.
- Increasing opportunity for home-based work tends to reduce political pressure for increasing social services—such as day care centers, and mainstream employment programs for the disabled—that would increase workers' options.
- A significant increase in home-based clerical work would tend to reduce the availability of conventional clerical jobs for those who need full-time employment.

Proponents of home-based work point to the benefits of expanding the individual's choice and control over his or her work, and the advantages to family life of having at least one parent remain in the home.

Any interventions to forbid, restrict, or regulate such work would need to be carefully designed to avoid placing an unintended burden on other kinds of home-based work, such as occasional "telecommuting" or small entrepreneurship.

Off-Shore Offices

The growing practice of sending data-entry work to be done in Third World countries poses the issue of protection for clerical jobs in the United States v. economic development policy goals and cost-reduction for U.S. companies.

Some U.S. firms are using advanced information and communications technologies to relocate their data-entry operations to other countries that offer low labor costs. Intermediary entrepreneurs make off-shore data and text-processing services available to other U.S. firms.

These services are most commonly performed in some Caribbean countries, but some is done in South America, India, and the Far East. English-speaking countries have been preferred, but experience has shown that English literacy is not necessary for most data-entry and word processing tasks. Data-entry clerks in Caribbean countries are typically paid about $15 to $60 (U.S.) weekly. In other countries wages may be much lower. At these costs, data can be entered two or three times and compared by the computer to detect and eliminate errors, thus achieving high accuracy.

U.S. economic development officials and the governments of Third World countries favor an increase in such activity; critics point out that it represents a direct loss of U.S. clerical jobs. Only a few thousand off-shore workers are now doing work originating in the United States. Thus, it has attracted little attention. Technological and economic factors will allow this activity to increase in the next decade. Entrepreneurs declare their intention of significantly expanding their offering of off-shore services.

Off-shore sourcing of data entry may, however, decline after about a decade, regardless of policy interventions to facilitate or inhibit it, if automation decreases the costs of data processing in the United States or new data-input technology sharply reduces the need for data-entry keyboarding. For this reason, actions to limit off-shore performance of clerical work may be unnecessary.

Public Sector Offices

The automation of government offices has implications for procurement and budgetary policy, personnel policies, delivery of government services, and the access of citizens to government information. Governments, as major employers, also have an obligation to government

employees to use automation for improving their worklife and improving their future employment opportunities.

Federal Office Automation Procurement

Procurement and acquisition policies have in general allowed the Federal Government to keep pace with the private sector in automating, and to adapt information and telecommunications technologies to the needs of public sector offices. The lack of compatibility among devices and systems, which is hampering the attempt to network computers within agencies and between agency headquarters and field offices, is, however, a significant problem. A second problem is that the lengthy procurement cycle is out of step with the rapid evolution of technology, so that government systems may not be state-of-the-art when installed. This is a problem chiefly with large and complex systems that push the state-of-the-art; complicated networks, for example. Finally, U.S. Government specifications sometimes make it difficult for vendors to offer innovative solutions to administrative problems in information-handling.

The Federal Government does not, in fact, know how many computers it has. The General Services Administration inventory of computers does not include those costing less than $50,000. This makes it difficult to assess the status of office automation, the level and rate of investment, and the results in terms of productivity and cost-reduction. Monitoring and inventory could be done without limiting the range of choice for agency decisionmakers.

Gains in government office productivity from automation, therefore, although obvious, are hard to measure and document. Many planning and justification documents use an estimate of 15 percent as an objective for short-term productivity gains. This may be too conservative. However, there are built-in disincentives in achieving maximum possible cost reductions. Government managers are offered few rewards, and may suffer subtle penalties, for reducing the number of employees they supervise or for cutting their annual expenditures. For example, one's civil service grade level or within-grade promotion depends in many cases on how many people one supervises; while unexpended funds can be used to justify a severely cut budget for the next fiscal year. Nevertheless, Administration policy has encouraged office automation as a way of reducing operating costs in the long term, and this strategy is likely to prove successful.

In some cases, automation has allowed agencies with a rapidly expanding workload—e.g., the Office of the U.S. Trade Representative—to cope without proportionately expanding its work force. There are also situations where automation allows services to the public that would not be possible without it; for example, responding to high volumes of requests for information from States, industry, or private citizens about Federal program entitlements, occupational hazards, or Federal-State aid programs. However, current policy emphasizes

cost-reduction in information-handling, rather than expansion of services.

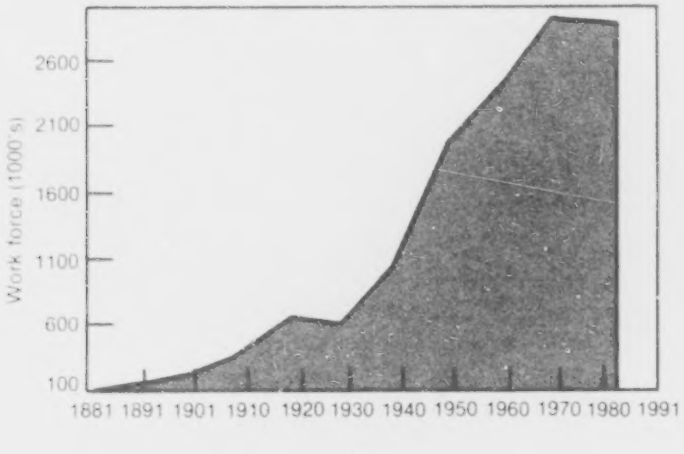
The Federal Office Worker

Given strong policy pressure to reduce the cost of government and the size of the Federal work force, office automation offers a promising strategy for achieving this objective. There are already some indications that office automation is allowing growth in Federal employment to be curbed, and possibly to be reversed.

Growth in Federal white-collar employment slowed significantly over the past decade, even as the ratio of white- to blue-collar workers continued to grow. The number of General Schedule civil servants grew by about 3 percent every 2 years from 1960 to 1974, but by about 0.3 percent every 2 years thereafter. There are now about 8 percent fewer civil servants in "General Administrative, Clerical, and Office Services" categories than there were in 1975. The proportion of Federal workers in clerical occupations (excluding postal workers) has declined from 31 to 25 percent in 10 years. It appears that the automation of Federal offices has facilitated if not directly caused these changes.

Reductions in the level of clerical employment and changes in job content and skill requirements are likely to accelerate. The changing ratio of clerical to professional employment may account for a significant amount of the slight shift upward in average grade level that has been criticized as "grade creep." This factor has not been ade-

Figure 3.—Paid Civilian Employment of the Federal Government, 1881-1983



SOURCE: Data from 1881-1980 based on U.S. Department of Commerce, Bureau of Census, *Historical Abstracts of the U.S. Colonial Times to 1970, Part II*, Series y 306-317. Washington, DC, 1975. Data from 1970-1983 based on U.S. Department of Commerce, Bureau of Census, *Statistical Abstracts of the United States*, N 523, Washington, DC, 1985.

quately considered either in analyses of current grade levels, or in planning for future Federal work force recruitment, assignment, retention, and retirement.

If the number of workers at lower grade levels decreases, as a result of office automation, and the average grade level is artificially constrained or reduced, as the Administration proposes, the ability of government to attract and hold highly qualified managers and professionals will inevitably suffer. Unless Federal personnel planners anticipate changes in work force needs well in advance, there could be more large and disruptive "reductions in force" (RIFS) in the future; these are painful for the individuals and organizations, demoralizing to other Federal workers, and disruptive to agencies.

The Administration is presently discouraging the allocation of funds to retraining of Federal workers whose offices are being automated. Experience in the private sector indicates that this makes it difficult to achieve the maximum benefits from office automation.

As the employer of nearly 2 million American office workers, the Federal Government has a heavy responsibility for minimizing the detrimental side effects of automation on these workers. As are other employers, the government is obligated to pay attention to the need for reasonable job security, training and retraining, opportunities for relocation and advancement, job satisfaction, the quality of the working environment, and the opportunity for employees to participate in decisions about their worklife.

The emerging effects of office automation on Federal employment, and their implications, should be thoroughly considered in relation to budgetary planning and formulation of policies regarding personnel recruitment, retention, promotion, retirement, job classification, equal opportunity, pay equity, and comparable worth. Congressional oversight and budget committees should emphasize these considerations in reviewing agency plans and actions.

State and Local Government Offices

The effects of automation on Federal, State, and local government offices are probably similar. There is wide diversity in the approaches that State and local governments have taken toward automating their offices. As yet, little is known about the overall effects of automation, although there are some impressive success stories. This report presents detailed case studies of office automation in the government of the State of South Carolina and that of New York City, to illustrate some of the results achieved and problems encountered.

The workload in most non-Federal government offices is increasing, in part because of shifting responsibilities for Federal-State programs. Thus, office automation is increasingly attractive to them. In spite of the opportunities presented by microcomputers, small cities and rural counties appear to be lagging in automating their offices, per-

haps because of lack of access to expertise in choosing and supporting technology and training workers.

The Quality of Governance

So far little is known about the aggregate effect of office automation on the quality and availability of government services to citizens at any level of government. Scattered evidence suggests that it can at the same time make services more timely and efficient, and lead to standardizing and formalizing the delivery of services in a way that decreases effectiveness and responsiveness to the needs of the client. In addition, there is concern that office automation, by changing the way that information is transmitted and exchanged, may erode established mechanisms for assuring accountability and legitimating authority and responsibility. These concerns merit watchful monitoring by those charged with oversight of government agencies.

Some Special Concerns

Office Automation in Small Businesses

Personal computers allow even very small firms to automate some of their office functions. The biggest barrier to automation in this sector is probably the difficulty of providing training and continuing advice, support, and trouble-shooting for small entrepreneurs and their employees on a day-to-day basis.

Firms with fewer than 100 employees play a major role in the American economy in terms of employment and new job creation, innovation, and supply of goods and services to small, dispersed, and specialized markets. They account for about 34 percent of American jobs and about one-third of sales. Optimists hope that automation may allow small businesses to expand their markets and compete with larger firms; pessimists fear that many of them will incur capital costs beyond their ability to support, or that automation, if successful, will erode their important role in creating new jobs. There is little empirical evidence as yet about the results of small business experience with office automation in the aggregate.

No Federal agency is systematically gathering information about office automation in the small business sector. Business people in this widely dispersed and fragmented, but vital, economic sector are left without a source of information and guidance in making their decisions, and government economic analyses suffer from lack of insight about possible effects on the economy as a whole. Congressional oversight committees may want to direct the Small Business Administration and the Departments of Labor and Commerce to study these neglected questions.

Working Women and Minority Workers

The effects of office automation are of particular concern to working women and to members of minority groups, who are now concentrated in jobs considered most vulnerable to office automation, and are also affected by the truncation of some job ladders when intermediate-level jobs are automated or redesigned. While computers and telecommunications have also created new jobs and new occupational specialties, in some of these (such as computer specialties) older patterns of differential pay and limited opportunity seem to be repeated. Changing skill requirements, and job titles and classifications that fail to change at the same time, introduce new complexities into already complicated debates about pay equity and comparable worth. Preparation for new jobs and learning new skills on their own time are particularly difficult for women who have heavy family responsibilities, are single parents, or are trying to reenter the job market after periods of full-time homemaking.

Members of minority groups only in recent decades have had access to office jobs as a gateway to middle-class status and upward mobility, and still tend to be differentially concentrated in lower levels of clerical work. To the extent that office automation reduces the number of office jobs, and particularly of clerical jobs, minority workers will be at greatest risk of displacement. Educational disadvantages exacerbate the problems of competing for jobs requiring familiarity with computers or the ability to learn new skills.

SUMMARY: OPPORTUNITIES AND EMERGING POLICY ISSUES

Many of the concerns that have been raised with regard to office automation are transition problems, inevitably associated with changes in basic technologies and economic structures. They can and will be solved in time by a combination of market forces, the common sense and ingenuity of the users of the technology, and the cooperative efforts of workers and managers. **Most transition problems do not require governmental action of any kind.**

Some emerging problems and possibilities—most importantly the possible effects on future office employment levels—are matters of long-term public interest. They may require some kind of policy intervention in the future, but there are many uncertainties about the probability of some of these effects, their timing, and their scope. Interventions, when necessary, must be prompt but must also be designed for effectiveness in the economic and political conditions that prevail at that

time. It will be difficult to design such interventions and implement them in a timely fashion unless government capability to anticipate and understand fundamental technological changes is greatly improved. **Steps to improve and integrate technological and employment forecasting are urgently needed.**

Another issue of long-term public interest is **the potential increase in part-time and temporary work**, and the resulting increase in the number of people and families without employee benefits and protections such as medical insurance, unemployment insurance, and pensions. This could lead to a lower overall level of social welfare or a greater burden of social welfare costs for the general taxpayer.

Suspected health problems associated with concentrated VDT work and computer-paced tasks are a current and growing issue on both National and State levels of government.

Other issues that are the subject of legislative proposals already before Congress or State legislatures include:

- proposals to encourage, regulate, or ban **home-based clerical work**;
- relationships between questions of **pay equity and comparable worth**, and changes in jobs and skill requirements as a result of office automation; and
- the **confidentiality and security of data** processed in small business computers and decentralized computer systems, and the vulnerability of critical operations in private and public sector organizations when essential information is stored only in electronic form.

Several issues are of concern to Congress in its role of **oversight of Federal agencies**; these include:

- the effects of present **procurement policies** and rules on the ability of Federal agencies to automate in a cost-effective way;
- the implications of office automation for present and **future personnel and compensation policies**, and the adequacy of planning and procedures to manage these effects;
- the question of whether there is sufficient protection for the **security and confidentiality of government data** that can be accessed by personal computers and associated networks; and
- the long-term effects of office automation on the **delivery of government services to individual clients.**

The issue of **data-entry work relocated off-shore** has received little attention as yet because the extent of such activity has been small, but will become more controversial if it increases as expected.

The effects of office automation on some institutions and some groups of people are of special concern. **Small businesses and small local governments** have much to gain by increased productivity but may have some special problems in capturing the benefits of new technology, and little information is yet available to help them in deciding when and how to make this investment. **Women and minority office**

workers are concentrated in jobs likely to be differentially affected by office automation and thus have strong concerns about its long-range consequences. This assessment has therefore given particular attention to the interests of these groups.

Attention to potential problems and policy issues should not, however, be allowed to obscure the promise that office automation holds. If judiciously implemented and wisely managed with a view to the legitimate interests of all parties, this basic technological advance can strengthen the American economy and advance the well-being of all Americans.

NOTE: Copies of the full report "Automation of America's Offices" can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, GPO stock No. 052-003-01013-5.

Assessments in Progress as of December 1985

Federal Government Information Technology: Key Trends and Policy Issues
Intellectual Property Rights in an Age of Electronics and Information
New Communications Technology: Implications for Privacy and Security
Wastes in the Marine Environment: Their Management and Disposal
Technologies To Control Illegal Drug Traffic
Hazardous Materials Transportation: Technology Issues
Science Policy Special Projects
Technology and the American Economic Transition
Western Surface Mine Reclamation
High-Technology Ceramics and Polymer Composites
Technology and Structural Unemployment: Reemploying Displaced Adults
International Competition in the Service Industries
Reduction of Industrial Hazardous Wastes
Technology Transfer to China
Alternatives for Improving NATO's Defense Response
Technology, Public Policy, and the Changing Structure of American Agriculture
Technologies To Maintain Biological Diversity
Integrated Renewable Resource Management for U.S. Insular Areas
Low Resource Agriculture in Developing Countries
Evaluation of Agent Orange Protocol
Technology and Indian Health Care: Effectiveness, Access, and Efficiency
Physician Payment and Medical Technology Under the Medicare Program
Technologies for Detecting Heritable Mutations
Technologies for Child Health
Alternatives to Animal Use in Research, Testing, and Education
Life-Sustaining Technologies and the Elderly
Disorders Causing Dementia
New Developments in Biotechnology

(NOTE: For brief descriptions of these studies in progress, see OTA booklet on "Assessment Activities"—available from OTA's Publishing Office, 224-8996.)

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